Validation of the Dutch version of the Chemotherapy-induced Taste Alteration Scale (CiTAS)

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Research Article

Keywords: Cancer, taste Change, Validation study, Chemotherapy-induced Taste alteration Scale (CiTAS), Confirmatory Factor Analysis

Posted Date: June 14th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-543006/v1

Abstract

Purpose: Taste and smell alterations are known side-effects of an oncological treatment with chemotherapy and can cause reduced food intake and lead to malnutrition and cachexia. ESPEN guidelines state that organizations should foresee a protocol to identify patients at nutritional risk and that screening should be available for all patients. The Chemotherapy-induced Taste alteration Scale (CiTAS) is described as a self -reported scale with a high reliability and validity. The aim of this study is to make a back translation and validation of the Chemotherapy-Induced Taste Alteration Scale in Dutch.

Methods: The evaluation instrument was constructed in a three-phased project. First, the Japanese version was backtranslated to Dutch and piloted in a cognitive interview. In a second phase, a Delphi procedure was followed. Context validity and Cronbach's alpha were calculated. In a third phase comfirmatory analysis was tested.

Results and conclusion: The overall Cronbach's alpha was 0.89. The convergent and discriminant validity show us that the items that should be related indeed are, like the items in the construct and that items that shouldn't, are not, as between the constructs. The scale was successfully backward translated and validated in Dutch and is ready to be used to screen Dutch speaking cancer patients with chemotherapy as a treatment for their cancer diagnosis. This version of CiTAS can be implemented in the Flemish speaking part of Belgium and in the Netherlands.

Plain Language Summary

1. Why is this study needed?

Currently, there is no scale available for Dutch speaking people to asses taste disorders due to chemotherapy.

2. What is the key problem/issue/question this manuscript addresses?

Taste and smell alterations are known side-effects of an oncological treatment with chemotherapy . Detecting the alterations can improve the effect of the therapy.

3. What is the main point of your study?

Our study makes a robust translation of an existing Japanese scale (CiTAS) with good statistical values.

4. What are your main results and what do they mean?

CiTAS-Nl was successfully backward translated and validated in Dutch and is ready to be used to screen Dutch speaking cancer patients with chemotherapy as a treatment for their cancer diagnosis.

1 Introduction

The oro-sensory perception of taste is a complex interaction of different senses. It has several important functions in life. It regulates food intake, tells us what we like and what we should not eat and activates neuronal pathways to start digestion, absorption and storage of nutrients [1]. A disturbance of taste perception, known as dysgeusia may affect our eating behavior and even our quality of life [2]. Taste and smell alterations can cause reduced food intake and lead to malnutrition and cachexia [3, 4]. Taste and smell disorders are known side-effects of an oncological treatment with chemotherapy. Spotten et al (2017) estimated the prevalence of taste changes due to chemotherapy on 20–70% and the changes of smell 16–46%[5]. Hutton et al reported of prevalence's from chemosensory abnormalities with 86% of the patients with advanced cancer [4]. Weight loss is a predictive factor in the response of a treatment with chemotherapy [6].

Screening can lead to a prediction of a better or worse outcome due to nutritional factors. Therefore, ESPEN guidelines state that organizations should foresee a protocol to identify patients at nutritional risk and that screening should be available for all patients. Nutritional screening instruments should have a high content validity and high reliability [7].

The Chemotherapy-induced Taste alteration Scale (CiTAS) is described as a self -reported scale with a high reliability and validation although it is yet insufficiently cited in literature[5, 8]. Originally, it was developed in Japan by Kano et al[9]. This scale was validated in Italian, Chinese and Turkish [10–12]. For Dutch-speaking patients, no instrument exists to rapidly screen for taste alterations.

According to Polit and Beck, back translation is an efficient process to achieve semantic equivalence[13]. The development process should be repeated in the target language [14]. To reduce survey error and to reassure that the questions will lead to considering what the author aimed for, cognitive interviewing is a valuable technique[15].

The aim of this study is to make a back translation and validation of the Chemotherapy-Induced Taste Alteration Scale in Dutch.

2 Methodology

The evaluation instrument was constructed in a three-phased project. First, the Japanese version of the questionnaire [9] was translated to Dutch and back-translated to Japanese. In a second phase, the Kane version of the CiTAS was presented to experts using the Delphi method. This method led to 4 additional items. During the third phase, the translated scales (original and enriched) were tested by submitting them to a number of participants. In the next paragraphs, we will go into further detail on the different stages of the instrument's construction.

2.1 Translation process

For the translation of the Japanese CiTAS, 3 native Japanese speakers were sought to perform the backward translation. The back translation was performed by two native Japanese translators. A third

translator compared the original with the back translated version of the CiTAS and judged them as identical. The clarity and the appropriateness of the Dutch version were tested through a monolingual cognitive interview with a Belgian cancer patient. Feedback from this interview led to adjusting the Dutch formulation of 1 item.

2.2 Content validity process

Three Delphi rounds with 6 experts were performed to achieve consensus on the Dutch content of the CiTAS-Nl. Experts were trained chefs gastro-engineering with a special training for taste steering techniques for patients with taste alterations. Feedback from these rounds resulted in 5 additional items (fish, chicken, metal, cotton and carboard). One item was deleted by the experts, “It is difficult to taste food”, due to perceived overlap in Dutch with “Unable to perceive the flavor of food”. In each round, the experts were asked to rate the items relevance to the test and give a score from 1 “not relevant” until 4 “highly relevant”. Table 1 demonstrates the final outcomes of these ratings. Three items had a low I-CVI “Everything tastes bad”: 0.67; “I have a cotton taste in my mouth”: 0.67; “Feeling nauseous or queasy”: 0.67. One of these items, “I have a cotton taste in my mouth”, was added by the experts in the Delphi procedure, the other two were original CITAS items. Nevertheless, all items were taken into account in the factor analysis since the overall CVI was adequate (0.91).

Table 1
Content Validity Index

CITAS item	Raters' agreement[1]	I-CVI[2]
1. Have difficulty tasting sweetness	6	1
2. Have difficulty tasting saltiness	6	1
3. Have difficulty tasting sourness	6	1
4. Have difficulty tasting bitterness	6	1
5. Have difficulty tasting umami	6	1
6. In general, the taste of my food has changed	6	1
7. Everything tastes bad	4	**0,67**
8. I do not perceive the original flavor of my food	6	1
9. Have a bitter taste in the mouth	6	1
10. Have a bad taste in the mouth	6	1
11. Have a metal taste in the mouth	5	0,83
12. Everything tastes bitter	5	0,83
13. Have a cardboard flavor in the mouth	6	1
14. Have a cotton flavor in the mouth	4	**0,67**
15. Feeling nauseous or queasy	4	**0,67**
16. Bothered by the smell of food	6	1
17. Have difficulty eating hot food	5	0,83
18. Have difficulty eating oily food	6	1
19. Have difficulty eating meat	6	1
20. Have a reduced appetite	5	0,83
21. Have difficulty eating chicken	5	0,83
22. Have difficulty eating fish	5	0,83
	S-CVI/Ave[3]	**0.91**

Note: All scale items are given in English but were adopted in Dutch in the original questionnaire. Dutch items can be found in appendix A

[1]Number of experts that scored 3 (quite relevant) or 4 (highly relevant) for this item. [2]Cut off score I-CVI 0.78. [3]Cut off score S-CVIAve 0.90

2.3 Participants

Adult (18+) cancer patients who underwent at least one treatment with chemotherapy were targeted. Patients with mouth and/or neck cancer or patients who got radiotherapy in the mouth or neck region, were excluded. Also suffering from stomatitis grade 2 or not being able to understand the written Dutch language, were an exclusion criteria. Initially, patients of three outpatient oncologic wards of hospitals in Antwerp were invited to complete the online survey by SL and MC. The survey was available by hyperlink or QR code. Due to Covid-19, all access to the hospitals was prohibited for researchers. Nursing students of Karel de Grote University College stepped in to help collect data on outpatient and inpatient oncologic ward. The survey was additionally spread by social media in patient groups in Flanders. This lead to some incomplete answers and patients not meeting the inclusion criteria. Only data from questionnaires that were filled in completely were taken into account.

Table 2 gives a brief overview of the patient characteristics. A convenience sample of 116 patients completely filled in the questionnaire. 74.1% were female. 51,7% off the patients suffered from breast cancer. Details about the different types of chemotherapy were not reported in this study report. Nevertheless, details can be delivered by the corresponding author.

Table 2
Sample characteristics (N = 116)

	N	%
Gender		
Male	30	25.9
Female	86	74.1
Cancer site		
Breast	60	51.7
Head	5	4.3
Liver, gallbladder, or bile duct	1	0.9
Lung	7	6.0
Lymphoma	4	3.5
Stomach	16	13.8
Other	23	19.8

3 Results Of The Validation Study

3.1 Exploratory Factor analysis

Exploratory factor analysis was used to identify the underlying structure behind the items. The exploratory factor analysis was performed with a Promax rotation as correlations between the factor could be expected. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (MSA) was calculated to test whether the data was adequate for Factor Analysis. The overall MSA elevated to 0.82 which is higher than the threshold of 0.80. With a minimum of 0.66, all items surpasses the item-threshold of 0.50. Table 3 gives an overview of the factor loadings and inter-factor correlations. With the exception of factor 3, all factor loadings reached the minimum level of 0.40. In Factor 3, the item “Have a cotton flavor in the mouth” was the only one not to reach the threshold of 0.40. However, as later analyses will show, there were indications not to delete this items from the factor.

Table 3
Dutch Chemotherapy-Induced Taste Alteration Scales, summary of Exploratory Factor Analysis with Promax rotation (N = 104, 22 items))

	Highest factor loading	Lowest factor loading	CF1	CF2	CF3
F1: Decline in basic taste (α = .87)	0.88	0.43	1.00		
F2: Discomfort (α = .81)	0.77	0.47	0.37	1.00	
F3: Phantogeusia and parageusia (α = .77)	0.79	0.32	0.30	0.36	1.00
F4: General taste alterations (α = .70)	0.62	0.46	0.34	0.39	0.26

Cronbach’s alpha was calculated for each subscale. Cut-off score for this inter-item correlation was set at 0.7. All scales met the minimum criterion for internal consistency. Each individual item was also evaluated and no item could be removed without decreasing the overall alpha value. Also the previously mentioned item on cotton flavor could not be removed from the *Phantogeusia and parageusia* subscale. The overall Cronbach’s alpha was 0.89 with no single item that could raise the measure when deleted from the scale.

3.2 Confirmatory Factor Analysis

Subsequently, we introduced the 22 items in a Confirmatory Factor Analysis using the SAS CALIS algorithm. This technique is the best qualified to extensively test the validity and reliability of the different scales [16, 17].

The confirmatory factor model shown in Table 4 provides a reasonable fit to the data. The χ^2 test of exact fit is significant, whereas the objective is to achieve a non-significant p-value. However, Hatcher [17] indicates that a significant χ^2 does not make a confirmatory factor analysis model inadequate. The χ^2 ratio shows that the ratio of the χ^2 value and the degree of freedom is lower than two (0.82). This indicates that the χ^2 test lies within acceptable limits [18]. It was not necessary to add any error covariances between scale items to obtain an acceptable fit. Table 4 gives an overview of all standardized factor loadings along with the standard errors and two-tailed *p*-values.

Table 4
Dutch Chemotherapy-Induced Taste Alteration Scales and scale items in the confirmatory factor analysis (N = 104)

	Standardised Factor Loadings	t-test	Probability t-test	R^2	Variance extracted
F 1: Decline in basic taste (ρ_c = .86)					0.55
F1.1 Have difficulty tasting sweetness	0,55	6,90	P < 0.001	0,30	
F1.2 Have difficulty tasting saltiness	0,82	20,83	P < 0.001	0,67	
F1.3 Have difficulty tasting sourness	0,86	22,61	P < 0.001	0,74	
F1.4 Have difficulty tasting bitterness	0,64	10,04	P < 0.001	0,41	
F1.5 Have difficulty tasting umami	0,80	19,05	P < 0.001	0,64	
F 2: Discomfort (ρ_c = .82)					0.40
F2.1 Feeling nauseous or queasy	0,48	5,85	P < 0.001	0,23	
F2.2 Bothered by the smell of food	0,74	14,08	P < 0.001	0,55	
F2.3 Have difficulty eating hot food	0,48	5,79	P < 0.001	0,23	
F2.4 Have difficulty eating oily food	0,71	12,23	P < 0.001	0,50	
F2.5 Have difficulty eating meat	0,57	7,67	P < 0.001	0,32	
F2.6 Have a reduced appetite	0,73	13,20	P < 0.001	0,53	
F2.7 Have difficulty eating chicken	0,66	10,24	P < 0.001	0,44	
F2.8 Have difficulty eating fish	0,48	5,85	P < 0.001	0,23	
F 3: Phantogeusia and parageusia (ρ_c = .77)					0.36
F3.1 Have a bitter taste in the mouth	0,56	7,03	P < 0.001	0,31	
F3.2 Have a bad taste in the mouth	0,79	13,90	P < 0.001	0,62	

Note: All scale items are given in English but were adopted in Dutch in the original questionnaire. Dutch items can be found in appendix A.

	Standardised Factor Loadings	t-test	Probability t-test	R^2	Variance extracted
F3.3 Have a metal taste in the mouth	0,63	8,86	P < 0.001	0,40	
F3.4 Everything tastes bitter	0,58	7,43	P < 0.001	0,34	
F3.5 Have a cardboard flavor in the mouth	0,53	6,40	P < 0.001	0,28	
F3.6 Have a cotton flavor in the mouth	0,46	5,20	P < 0.001	0,21	
F 4: General taste alterations (ρ_c = .73)					0.48
F4.1 in general, the taste of my food has changed	0,76	14,90	P < 0.001	0,58	
F4.2 Everything tastes bad	0,78	15,60	P < 0.001	0,61	
F4.3 I do/no not perceive the original flavor of my food	0,50	6,17	P < 0.001	0,25	
Note: All scale items are given in English but were adopted in Dutch in the original questionnaire. Dutch items can be found in appendix A.					

Scale composite reliability: $\rho_c = \left[\left(\sum \lambda_i\right)^2 \mathrm{var}(\xi)\right] / \left[\left(\sum \lambda_i\right)^2 \mathrm{var}(\xi) + \sum \theta_{ii}\right]$ [1: 80].

Fit statistics for confirmatory factor analysis of 22 indicators for 10 constructs: $\chi^2_{(231)} = 294.73$, $p = .00$; GFI = .80; CFI = 0.87.; NNFI = .85; RMSEA = .07.

Within each construct, all factor loadings are significant and greater than .40. Also the item “cotton flavor” (0.46) in the *Phantogeusia and parageusia* scale now reaches the minimum threshold of 0.40. This is again support of our decision to keep the item in the scale despite the low factor loading in the exploratory factor analysis.

We calculated the composite reliability of all factors (comparable to Cronbach’s alpha within the framework of exploratory factor analysis) [17]. All factors achieve the lower threshold of 0.70. Indicator reliability is shown by the sufficient R’s of all items indicating sufficient variance was explained for each original item in the constructs.

In terms of validity of the constructs, convergent validity is evidenced by the large and significant loadings of the items on their posited factors. Further evidence of convergent validity is shown in Table 4. None of the correlations between the latent constructs are too high to challenge the convergent validity of the constructs.

Discriminant validity of the construct is shown because the confidence interval (± two standard errors) around the correlation estimate between any two latent constructs never equals 1.0 [20: 416]. The Variance Extracted Test also demonstrates the discriminant validity of our constructs. This test compares the variance extracted from two latent constructs with the square of the correlation between these two constructs [21]. Discriminant validity is shown whenever the explained variance is greater than the squared correlation. All pairs of factors have been compared and they all showed an acceptable variance extracted.

4 Discussion And Conclusion

CiTAS is a validated, internationally used instrument to detect taste alterations due to a treatment of chemotherapy regimens. The scale was successfully backward translated and validated in Dutch and is ready to be used to screen Dutch speaking cancer patients with chemotherapy as a treatment for their cancer diagnosis. This version of CiTAS can be implemented in the Flemish speaking part of Belgium and in the Netherlands. In congruence with the international abbreviations, the Dutch version can be referred to as CiTAS-NL.

The sample that was used for the validation process was limited due to prohibited access to patients caused by the pandemic. This can be seen as a disadvantage of this study. However the statistical analysis demonstrates adequate reliability and validity. Furthermore, the crosscultural validation of CiTAS led to an enrichment of the original CiTAS. The experts added five additional items and deleted one other. The exploratory analysis demonstrates that all items passed the thresholds for the factor analysis (MSA 0.82). With the additional items included, the internal consistency was calculated. The overall Cronbach's alpha was 0.89. Finally, the convergent and discriminant validity show us that the items that should be related indeed are, like the items in the construct and that items that shouldn't, are not, as between the constructs.

With CiTAS-NL, nurses working with patients suffering from cancer, can rapidly and easily detect the patients at risk for malnutrition due to taste alterations. In addition, CiTAS-NL can be used to follow effect of intervention of taste steering as an intervention to taste alterations.

Declarations

Funding:

This research was supported by 'Kom Op Tegen Kanker' a non-governmental organization in Flanders, Belgium https://www.komoptegenkanker.be/

Conflicts of interests: No conflicts of interest do exist on this study.

Availability of data and material: Any material is available by contacting the corresponding author.

Code availability: Data are available in excel, analyses in SAS

Authors' contributions: MC and SL collected the data, MC, SL and DM analyzed the data, MC, DM and BG attributed to the text. All authors approved of the final version of the study.

Ethics approval:

This study was approved by the central Ethics Committee of the Antwerp University Hospital (UZA), record number 19/45/520 and the Ethics Committee of Antwerp Hospital Network (ZNA), record number 5298.

Consent to participate (include appropriate statements)

All participants signed a written informed consent in advance.

Consent for publication

A written permission from the author of the Japanese CiTAS was obtained by email.

Acknowledgments:

Authors wish to thank the nursing students from Karel de Grote University College for their help during data collection.

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- AppendixA.docx